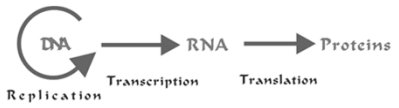
Protein Synthesis: Transcription

Beadle & Tatum

- One gene-one enzyme hypothesis
  - used x-rays to create mutations in mold
  - Discovered that one gene codes for one enzyme
- Led to the one gene-one polypeptide hypothesis (not one gene-one protein)

The Central Dogma of Molecular Biology



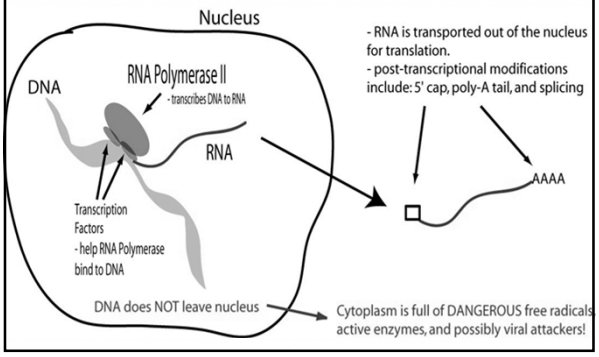
Describes the flow of genetic information from DNA to RNA to proteins

*Replication *Transcription *Translation

Summary of Replication

- Leading Strand—1 primer; 5' to 3' continuous
- Lagging Strand—multiple primers; 5' to 3' discontinuous
- DNA polymerase adds nucleotides very efficiently in eukaryotes
- Proofreading ability

Transcription-overview



RNA Synthesis: Transcription

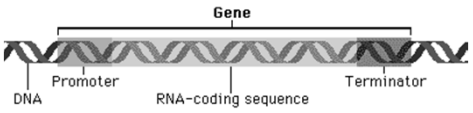
- RNA is a nucleic acid that plays several roles in production of proteins
- RNA is necessary to carry the information on DNA out of the nucleus to the ribosomes in the cytoplasm (or on ER)

RNA Synthesis: Transcription

- There are 3 types of RNA:
  - mRNA—messenger RNA; encodes the amino acid sequence of a polypeptide
  - tRNA—transfer RNA; brings amino acids to ribosome during translation
  - rRNA—ribosomal RNA; along with ribosomal proteins, makes up the ribosome

RNA Synthesis: Transcription

- Making mRNA starts with a protein-encoding gene on a template strand of DNA



Transcription: Step 1

Initiation

- RNA polymerase binds to a promoter, which is a region of bases that signal the beginning of a gene
- RNA polymerase is bound to the TATA box by transcription factors
- The double helix unwinds and is ready to be transcribed

Transcription: Step 2

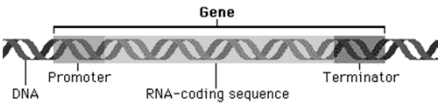
Elongation

- RNA polymerase moves along the encoding gene adding nucleotides in the 5' to 3' direction and complementary to the DNA template strand

Transcription: Step 3

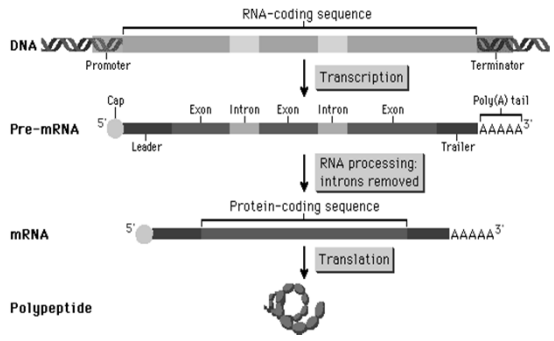
Termination

- RNA polymerase reaches the terminator region of the encoding gene.
- All the enzymes and factors are released.
- The product of these 3 steps is called pre-mRNA (immature).



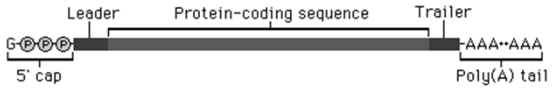
RNA Processing

- Most eukaryotic protein-encoding genes contain non-coding segments, called introns, which are between the amino acid coding segments, called exons.
- RNA processing involves modification and splicing.



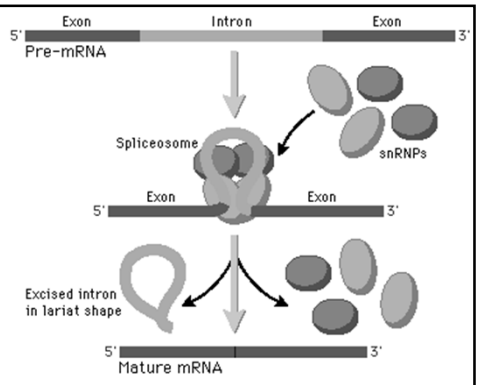
Modification of pre-mRNA

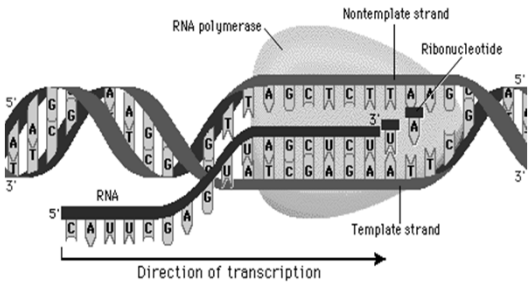
- At the 5' end, a cap is added.
- This occurs at the beginning of transcription. The 5' cap is used as a recognition signal for ribosomes to bind to the mRNA.
- At the 3' end, a poly(A) tail is added. The tail plays a role in the stability of the mRNA.



Splicing

- **The intron loops out as snRNPs (small nuclear ribonucleoprotein particles) bind to form the spliceosome.**
- **The intron is excised, and the exons are then spliced together.**
- **Results in mature mRNA, which will then exit the nucleus and be translated in the cytoplasm.**





Transcription Animation